

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 August 2003 (07.08.2003)

PCT

(10) International Publication Number
WO 03/065699 A1

(51) International Patent Classification⁷: **H04M 3/30**,
H04Q 1/14

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(21) International Application Number: **PCT/IT03/00033**

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(22) International Filing Date: 29 January 2003 (29.01.2003)

(25) Filing Language: Italian

(26) Publication Language: English

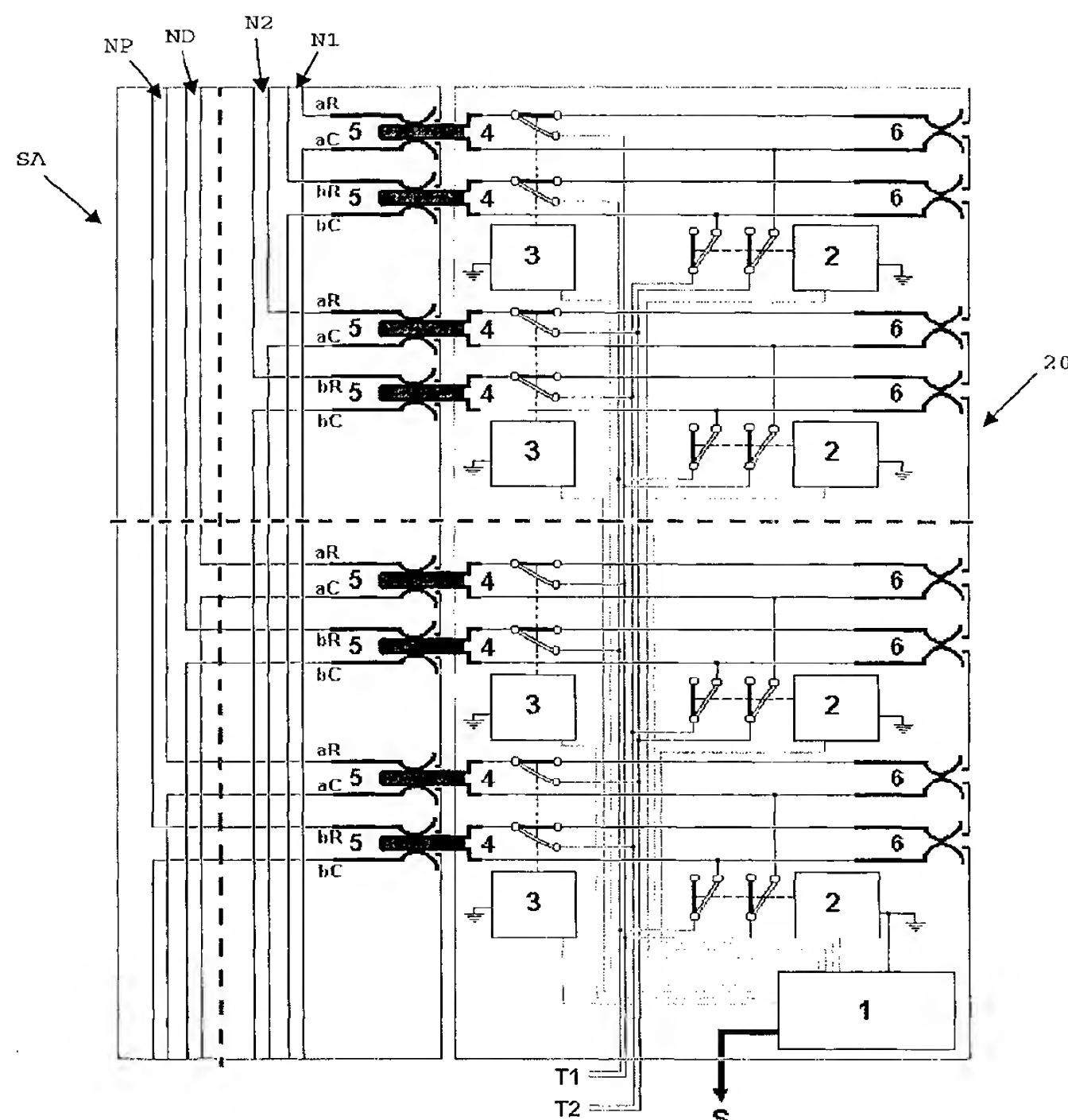
(30) Priority Data:
RM2002A000050 30 January 2002 (30.01.2002) IT
RM2002A000623 16 December 2002 (16.12.2002) IT

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI,

[Continued on next page]

(54) Title: APPARATUS FOR MANAGEMENT AND REMOTE CONTROL OF ELECTRICAL CHARACTERISTICS OF EACH WIRE PAIRS CONNECTED TO A TELEPHONE EXCHANGE AND TO A DISTRIBUTION FRAME



(57) Abstract: An apparatus for the management and the remote and/or automatic control of electric characteristics and signal transmissivity of the metallic line pairs connected to a telephone exchange (C), comprising measurement means and means able to connect said measurement means to the single line pairs connected to the telephone exchange and then to all of the lines of a distribution whether they are active or redundant.



SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

- *with international search report before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

APPARATUS FOR MANAGEMENT AND REMOTE CONTROL OF ELECTRICAL CHARACTERISTICS
OF EACH WIRE PAIRS CONNECTED TO A TELEPHONE EXCHANGE AND TO A DISTRIBUTION
FRAME

The present invention relates the field of the dial
telephone systems and particularly an apparatus for
monitoring electric characteristics and signal
transmissivity in line pairs (usually of copper or
5 aluminium) connected to exchanges.

With the liberalization of the telecommunication
systems, the major Telephone Companies, once holder of
the monopoly, have been compelled to drastically
10 reduce the cost in order to be competitive with the
competition of the new Telecommunication Managers.

The prevailing reason of this is the unbalance
situation between, on one side, the new Managers
having only to pay the rent for telephone networks and
15 services, and, on the other side, the Telephone
Companies, once holder of the monopoly, that are
burdened with the cost of operation and maintenance of
the access network requiring a significant amount of
human resources because of the lack of automatic
20 control system, thus generating an important item in
the budget of such companies.

However, the cutting of the investment regarding
operation and maintenance has the fated consequence of
the network quality degradation as far as the quality
25 of the signal and the data transmission rate is
concerned.

Regarding the situation of the Company Telecom Italia, the cutting of the budget in recent years have increased the failure rate of the network (number of failures per 100 km cable in a year) from 5-6% of 1997 to 13-14% of today.

Such a situation is further emphasized by the wide band services (ADSL) which need better electric characteristics of the network to operate correctly, thus compelling the Manager to a preventive, quick, effective intervention for improving the efficiency of the lines and to solve the problems on pain of the commercial failure.

On the other side, no Telephone Company can be burdened with the cost of such activity if the latter is carried out by the traditional intervention of technicians.

Therefore, it is self-evident that with the coming of new digital wideband services, in order to achieve a good reliability and quality of the access network with successfully commercial consequences and customer satisfaction as well, it is necessary to perform a new management of the network based on the preventive control of the lines according to the technical requirements of the new services that cannot absolutely be implemented both technically and economically by the traditional modes of operation.

In other words the old operation methods performing an intervention on the network only following a customer's failure notice are extremely burdensome with respect to the new scenery and cause troubles to

the customer.

In order to overcome such problems, worldwide telecommunication equipment manufacturing companies such as Teradyne, Sunrise, Turnstone, etc., have
5 provided remote controlled systems for line testing and access network failure detection tested by Telecom Italia, British Telecom, Colt, Cable & Wireless, etc. The results have been deemed by the Managers not satisfactory because of the lack of reliability of the
10 measurements carried out by such systems. For this reason, a system able to solve this crucial problem is still being developed all over Europe and particularly by British Telecom that first has been looking for a system able not only to test the characteristics of a
15 line but also to detect automatically network failures.

The main object of the present invention is to provide an apparatus able to carry out automatically and
20 remotely the monitoring of the dial telephone systems (e.g. copper or aluminium) to test electric characteristics and signal transmissivity.

A second object of the invention is to provide means for testing the quality of the lines as far the
25 electric characteristics and the signal transmission rate is concerned, which means does not require any re-wiring of the line pairs or modification of the exchange apparatus to which such line pairs are connected.

30 A third object of the invention is to provide an

apparatus able to test both the line pairs connected to customers and the redundant line pairs and those rented by other managers independent of that they are audio lines, digital lines (ISDN) or wideband lines (ADSL).

This has been accomplished according to the present invention by providing an apparatus which can be remote controlled in any exchange, comprising measurement means and means for the connection of such measurement means to the single line pairs connected to the exchange as well as to all of the lines connected thereto whether they are active or redundant.

A better understanding of the invention will result from the following description with reference to the accompanying drawings of the known exchanges and two preferred embodiments thereof shown only by way of a not limiting example.

In the drawings:

Figure 1 is a diagram showing an exchange of the known type to which the access network is connected;

Figure 2, similar to the preceding figure, shows the installation of a measurement unit of the know type in the exchange that is connected to the autoswitch of the exchange according to already tested techniques;

Figure 3 shows schematically an exchange of the known

type in which the apparatus according to the present invention is installed;

Figure 4 is a block diagram of the apparatus according to the invention;

Figure 5 is an exemplifying wiring diagram of a first embodiment of an interface device by which the measurement means is connected to the single line pairs connected to the exchange; and

Figure 6, similar to the preceding figure, shows a second simplified embodiment of an interface device according to the invention.

In order to illustrate in a more detailed way the scenery to which the invention is related, reference is made first to figures 1 and 2.

From the diagram of figure 1 it appears that all of the lines connected to a customer are conveyed to a permutator P. The audio service dedicated lines F are connected directly to autoswitch AC, while ADSL (wideband) lines pass before being connected to the autoswitch through a device DSLAM of the known type that provides the wideband service by separating the same from the audio signal by a pots filter PF of the known type.

Control and measurement systems developed so far provide, as shown in the diagram of figure 2, the installation of a remote controlled measurement device

in the exchange which is able to measure and to control the lines directly connected to the autoswitch by means of a known function of the autoswitch AC.

Although such a solution has the advantage of being brought about by only connecting a measurement unit to autoswitch AC, it has the following limits which has made it unsuccessful:

1. The quality of the qualification measurements is insufficient because of the limits caused by the transit of the line through autoswitch AC;
2. In case of an ADSL line, once the preventive qualification measurements are carried out and the service is activated, the line cannot be tested any longer by such system because of the already described separation filter PS which is connected between autoswitch AC and the line;
3. As the access network is designed with a redundancy of about 40% (every 100 lines from exchange C, 60 lines connect customers and 40 lines are only connected to permutator P and left as spare), all of the spare lines are not managed by the measurement system described above as they are not connected to the autoswitch;
4. The same limit of the preceding item is valid for all of the lines rented to other operators (unbundling).

Modern exchanges are usually provided, as an alternative to the permutator P, with a switch matrix access, however, the use of such matrixes in the already existing exchanges in which the lines are

connected to a permutator cannot be applied in praxis due to the high cost involved by such operation.

The diagram of figure 3 shows the solution according to the present invention, characterized by the installation of a remote controlled test and measurement device 10 at the exchange C which includes measurement apparatus connected to suitable devices 20 installed in the permutator P which are able to connect to all of the lines arriving to such permutator and then to all of the line pairs from the exchange which are either connected to a customer (rented) or redundant.

Such a solution allows the connecting device 20 to be connected to all of the lines and the above-mentioned limits of the known systems to be overcome, thus ensuring a complete, economic control of the access network because of the monitoring of all lines.

For example, the lines for any service, included the wideband service, can be qualified completely and advantageously both from the technical and economical point of view as the intervention of technicians in situ is not required. In case of failure, the system is able to detect remotely the point of failure, thus allowing the repair and the on line control of the quality of such repair. In addition, the invention is able both to detect the degradation of the lines and to locate any failure by a suitable software for monitoring continuously the lines, all of this being executed automatically with evident cost savings as well as improvements in the organization and the image

to customers.

It is advisable now to disclose the measurement and control apparatus 10 and the relative connecting devices 20 according to the invention, that are
5 installed in the strips connecting the line pairs (external telephone network) to the permutator P and are controlled directly by the measurement apparatus disclosed.

With particular reference to figures 3 and 4, the
10 present invention includes essentially:

- a measurement and control apparatus 10;
- a plurality of connecting devices 20 with the single connecting strips SA;
- a number of interface devices M, one for each column
15 of permutator P, which connect the connecting devices 20 to the measurement and control apparatus 10.

More specifically the measurement and control apparatus 10 includes: means for the communication
20 with the remote control centre; means for the measurement of the electric quantities and the transmission signals in the line pairs connected to exchange C; means for storing, processing and controlling signals received from/transmitted to the
25 remote control centre; power supply means; a driver controlling the communication between the single line pair to be tested and the measurement means by driving the interface devices M and connecting devices 20.

It should be noted that each interface device M
30 installed at the top of the respective column of the

permutator P (or in another suitable position) is able to connect the selected line pair(s) to the measurement means according to the control signals received from such processing and control means in order to connect the connecting device 20 of each column to the measurement and control apparatus 10.

Each interface device M is connected to the other interface apparatus and the measurement and control apparatus 10 by two measurement line pairs T1 and T2 and a common control bus S.

In the preferred embodiment disclosed, each of them is provided with a serial gate by which the switching of the line pairs to the test terminal of line pairs T1 and T2 is controlled.

Furthermore, such interface devices M are able to recognize a tone transmitted from the external network or the exchange to test again the line pairs and to re-arrange the numbers of the exchange to the permutator P.

Each connecting device 20 shown schematically in figure 5 is connected to the interface device M corresponding to its column by two measurement line pairs T1-T2 and a control bus S.

Referring to the latter figure, it should be noted that according to a peculiar feature of the invention such connecting device 20 is able to connect, to section, and to transfer each line pair connected to the permutation strips, thus making them available to the above-mentioned measurement means.

According to the invention, this is advantageously

carried out without the need of modifying in any way the existing wiring of permutator P. Only the first two line pairs N1, N2 and the n-th line pairs ND, NP are shown in the figure for the sake of clarity.

5 Each connecting-sectioning-transferring device 20 which is characterized by a low parasitic capacitance acts as a multiple sectioning plug and reproduces the exact geographic allocation of the sectioning points of the several existing vertical or horizontal
10 connecting strips both on the side interfacing the existing strip SA and the side of the operators. The installation requires only the insertion of the single connecting devices or modules 20 into the respective connecting strips SA of the line pairs of the
15 permutator P.

Each connecting-sectioning-transferring device 20 consists of a body which includes by way of a not limiting example two shells forming the two operating sections.

20 The "male" section interfacing connecting strips SA of permutator P is provided with the sectioning plugs 4 that once inserted into the corresponding sectioning points 5 establish both the mechanical connection between the existing strip SA and module 20 and the
25 galvanic connection of each single connected line pair without the need of modifying the existing wiring.

Once the connecting-sectioning-transferring device 20 is connected, each generic line pair connected to the network side "ar, br" of the sectioning point 5 of
30 strip SA of permutator P is sectioned and galvanically

interrupted by the contacts of the sectioning plug 4.
According to the invention, two on-line relays are
provided for each line pair: a first sectioning relay
3 connected in series, and a second monitoring
5 "sniffer" relay 2 connected in parallel.

The rest contacts of sectioning relay 3 ensure the
normal continuity of the line pair before the
connection of device 20, thus making such line pair
available to the central side "ac, bc" of the
10 sectioning point 5 through the rest contacts of the
corresponding sectioning points 6 of the "female"
section of device 20 which further put again in
operation the strip in case the same line pair should
be sectioned locally.

15 Suitably coded control signals relative to the line
pair to be tested and the type of test to be executed
are fed to an actuator 1 through bus S.

Accordingly, actuator 1 activates one of the
sectioning relays 3 or monitoring relays 2 according
20 to whether an intrusive or non-intrusive measurement
has to be carried out, and gives back a signal
indicating the established connection.

In case of an intrusive measurement, the action of
relay 3 provides for sectioning a line pair so that
25 the side of the network is made available on the test
line pairs T1 if it is odd, and T2 if it is even.

In case of a non-intrusive measurement, relay 2 puts
test line pair T2, if it is odd, or T1, if it is even,
in parallel with the line to be tested.

30 The simultaneous action of the two sectioning relays

3, one for the even line pairs, the other for the odd line pairs, allows the network side of the two line pairs to be connected simultaneously to the measurement unit.

5 The simultaneous action of the two line relays 2 and 3 of a single line pair allows the network side and the exchange side of the tested line pair to be made available alternatively according to whether the selected line pair is odd or even.

10 As already mentioned, each connecting-sectioning-transferring module 20 is connected to other modules and the measurement and control apparatus 10 by only two test line pairs T1-T2 and a common bus S.

Advantageously, according to the invention, the
15 relevant peculiarity of which is to avoid the need of wiring again each single line pairs connected to permutator P, thus also avoiding to twist the existing installation, it is possible to test all of the line pairs, thus optimizing the use of the high-technology
20 apparatus disclosed herein which is able to carry out measurements without any need of providing new services and to provide a measurement and test system characterized by a great simplicity, cheapness, and installation velocity.

25 At last, it should be appreciated that the present invention allows qualification measurements, certifications, maintenance and failure detection to be carried out all over a network of a determined area directly from a control centre as well as any
30 degradation of the line pairs and any failure to be

automatically detected by a suitable software.

A second embodiment of the invention has connecting device 20' simplified with respect to those described so far. In fact, in this second embodiment each
5 connecting device 20' is provided with only two line pairs to carry out measurements and to be controlled, only one test line pair T and a bus S.

As it has been described in the preceding embodiment, once the connecting-sectioning-transferring module 20' is connected, each generic line pair connected to the
10 network side "lr" of the sectioning point 5 of strip SA of permutator P is sectioned and galvanically interrupted by the contacts of the sectioning plug 4.

According to the invention, two on line relays are provided for each line pair: a first sectioning relay
15 3 connected in series, and a second monitoring "sniffer" relay 2 connected in parallel.

The rest contacts of sectioning relay 3 ensure the normal continuity of the line pair before the
20 connection of device 20', thus making such line pair available to the central side "lc" of the sectioning point 5 through the rest contacts of the corresponding sectioning points 6 of the "female" section of device 20' which further put again in operation the strip in
25 case the same line pair should be sectioned.

Suitably coded control signals relative to the line pair to be tested and the type of test to be executed are fed to an actuator 1 through bus S.

Accordingly, actuator 1 activates one of the
30 sectioning relays 3 or monitoring relays 2 according

to whether an intrusive or non-intrusive measurement has to be carried out, and gives back a signal indicating the established connection.

5 In case of an intrusive measurement, the action of relay 3 provides for sectioning a line pair so that the side of the network is made available on the test line pairs T.

10 In case of a non-intrusive measurement, relay 2 puts test line pair T in parallel with the line to be tested.

As already mentioned, each connecting-sectioning-transferring module 20' is connected to other modules and the measurement and control apparatus 10 by only one test line pair T and a common bus S.

15 The present invention has been described and illustrated according to two preferred embodiments thereof, however, it should be understood anyone skilled in the art can make technically and/or functionally equivalent modifications and/or
20 replacements without departing from the scope of the present industrial invention.

Claims

1. An apparatus for the management and the remote and/or automatic control of electric characteristics and signal transmissivity in the metallic line pairs connected to a telephone exchange (C), characterized in that it includes measurement means and means able to connect said measurement means to the single line pairs connected to the telephone exchange and then to all of the lines whether they are active or redundant.

2. The apparatus according to the preceding claim, characterized in that it includes measurement apparatus connected to suitable devices (20, 20') installed in at least a permutator (P) of the exchange (C) which are able to connect to all of the lines arriving to such permutator and then to all of the line pairs from the exchange (C) which are either connected to a customer (rented) or redundant, said control and measurement apparatus being able to be installed in an exchange (C) and to be remote controlled via cable, or via ether, or locally controlled.

3. The apparatus according to the preceding claim, characterized in that in order to monitor all of the telephone lines in a complete and extremely economic way there is provided the connection of the connecting device (20', 20) to all of the lines, thus obtaining that in case of failure, the system is able

to detect remotely the point of failure, thus allowing the repair in situ and the on line test of the quality of such repair.

5 4. The apparatus according to any preceding claim, characterized in that it includes essentially:

- a measurement and control apparatus (10);
- a plurality of connecting devices (20', 20) with the single connecting strips (SA);
- 10 - a number of interface devices (M), one for each column of permutator (P), which connect the connecting devices (20', 20) to the measurement and control apparatus (10).

15 5. The apparatus according to the preceding claim, characterized in that the measurement and control apparatus (10) includes:

- means for the communication with the remote control centre;
- 20 - means for the measurement of the electric quantities and the transmission signals in the line pairs connected to exchange (C);
- means for storing, processing and controlling signals received from/transmitted to the remote control centre;
- 25 - power supply means;
- a driver controlling the communication between the single line pair to be tested and the measurement means by driving the interface devices (M) and
- 30 connecting devices (20', 20).

6. The apparatus according to the preceding claim, characterized in that each interface device (M) is installed at the respective column of permutator (P) in order to connect the connecting devices (20', 20) of each column to the measurement and control apparatus (10) and is able to connect the selected line pair(s) to the measurement means according to the control signals received from such processing and control means.

7. The apparatus according to the preceding claim, characterized in that each interface device (M) is connected to other interface apparatus and the measurement and control apparatus (10) by one or more measurement line pairs (T, T1-T2) and a common control bus (S).

8. The apparatus according to the preceding claim, characterized in that each interface device (M) is provided with a serial gate by which the switching of the line pairs to the test terminal (T) or the test terminal of the first (T1) and the second (T2) line pairs is controlled.

9. The apparatus according to the preceding claim, characterized in that such interface devices (M) are able to recognize a tone transmitted from the external network or the exchange to test again the line pairs and to re-arrange the numbers of the

exchange to the permutator (P).

10. The apparatus according to the preceding claim, characterized in that each connecting device
5 (20', 20) is connected to the interface device (M) corresponding to its column by one or more measurement line pairs (T, T1-T2) and a control bus (S).

11. The apparatus according to the preceding
10 claim, characterized in that said connecting device (20', 20) is able to connect, to section, and to transfer each line pair connected to the permutation strips, thus making them available to the above-mentioned measurement means, each connecting-
15 sectioning-transferring device (20) acting as a multiple sectioning plug and reproducing the exact geographic allocation of the sectioning points of the several existing vertical or horizontal connecting strips both on the side interfacing the existing strip
20 (SA) and the side of the operators.

12. The apparatus according to the preceding claim, characterized in that each connecting-
sectioning-transferring device (20', 20) consists of a
25 body which includes two shells forming the two operating "male" and "female" sections, respectively, the second of which reproduces exactly the sectioning points (5) in which the male section is inserted.

30 13. The apparatus according to the preceding

claim, characterized in that the "male" section of the connecting-sectioning-transferring device (20', 20) for interfacing the common connecting strips (SA) of permutator (P) is provided with the sectioning plugs (4) that once inserted into the corresponding sectioning points (5) establish both the mechanical connection between the existing strip (SA) and module (20', 20) and the galvanic connection of each single connected line pair without the need of modifying the existing wiring, each generic line pair connected to the network side (lr, ar-br) of the sectioning point (5) of strip (SA) of permutator (P) being sectioned and galvanically interrupted by the contacts of the sectioning plug (4).

15

14. The apparatus according to the preceding claim, characterized in that the connecting-sectioning-transferring device (20', 20) includes two on-line relays for each line pair: a first sectioning relay (3) connected in series, and a second monitoring "sniffer" relay (2) connected in parallel.

20

15. The apparatus according to the preceding claim, characterized in that the rest contacts of sectioning relay (3) ensure the same normal continuity of the line pair as before the connection of device (20', 20), thus making such line pair available to the central side (lc, ac-bc) of the sectioning point (5) through the rest contacts of the corresponding sectioning points (6) of the "female" section of

25

30

device (20', 20) which further put again into operation the strip in case the same line pair should be locally sectioned.

5 16. The apparatus according to the preceding claim, characterized in that the connecting-sectioning-transferring device (20', 20) is provided with an actuator module (1) which, after having received suitably coded control signals relative to
10 the line pair to be tested and the type of test to be executed through bus (S), activates one of the line relays (3 or 2) present in the device according to whether an intrusive or non-intrusive measurement has to be carried out, and gives back a signal indicating
15 the established connection.

 17. The apparatus according to the preceding claim, characterized in that in order to carry out an intrusive measurement, the action of first relay (3)
20 provides for sectioning a line pair so that the side of the network is made available on the test line pair (T) or on the first test line pairs (T1), if it is odd, and on the second test line pairs (T2), if it is even.

25 18. The apparatus according to claim 16, characterized in that in order to carry out a non-intrusive measurement, second relay (2) puts test line pair (T) or the second test line pair (T2), if it is
30 odd, or the first line pair (T1), if it is even, in

parallel with the line to be tested.

19. The apparatus according to claims 17 and 18, characterized in that the simultaneous action of the two first relays (3), one for the even line pairs, the other for the odd line pairs, allows the network side of the two line pairs to be connected simultaneously to the measurement unit, while the simultaneous action of the first and second relays (3 and 2) of a single line pair allows the network side and the exchange side of the tested line pair (T) or the first and second test line pairs (T1-T2) to be made available alternatively according to whether the selected line pair is odd or even.

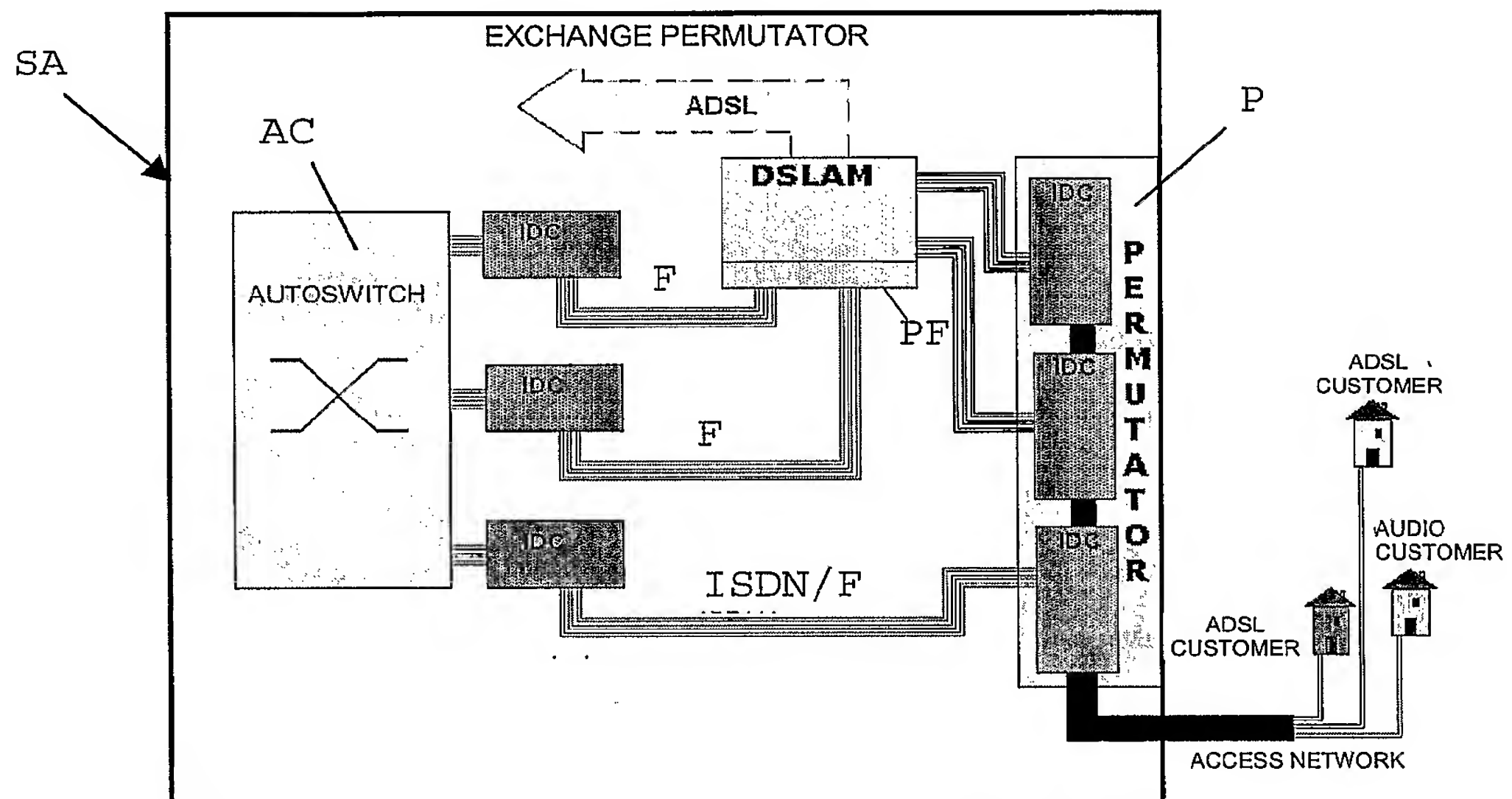
PRIOR ART

FIG. 1

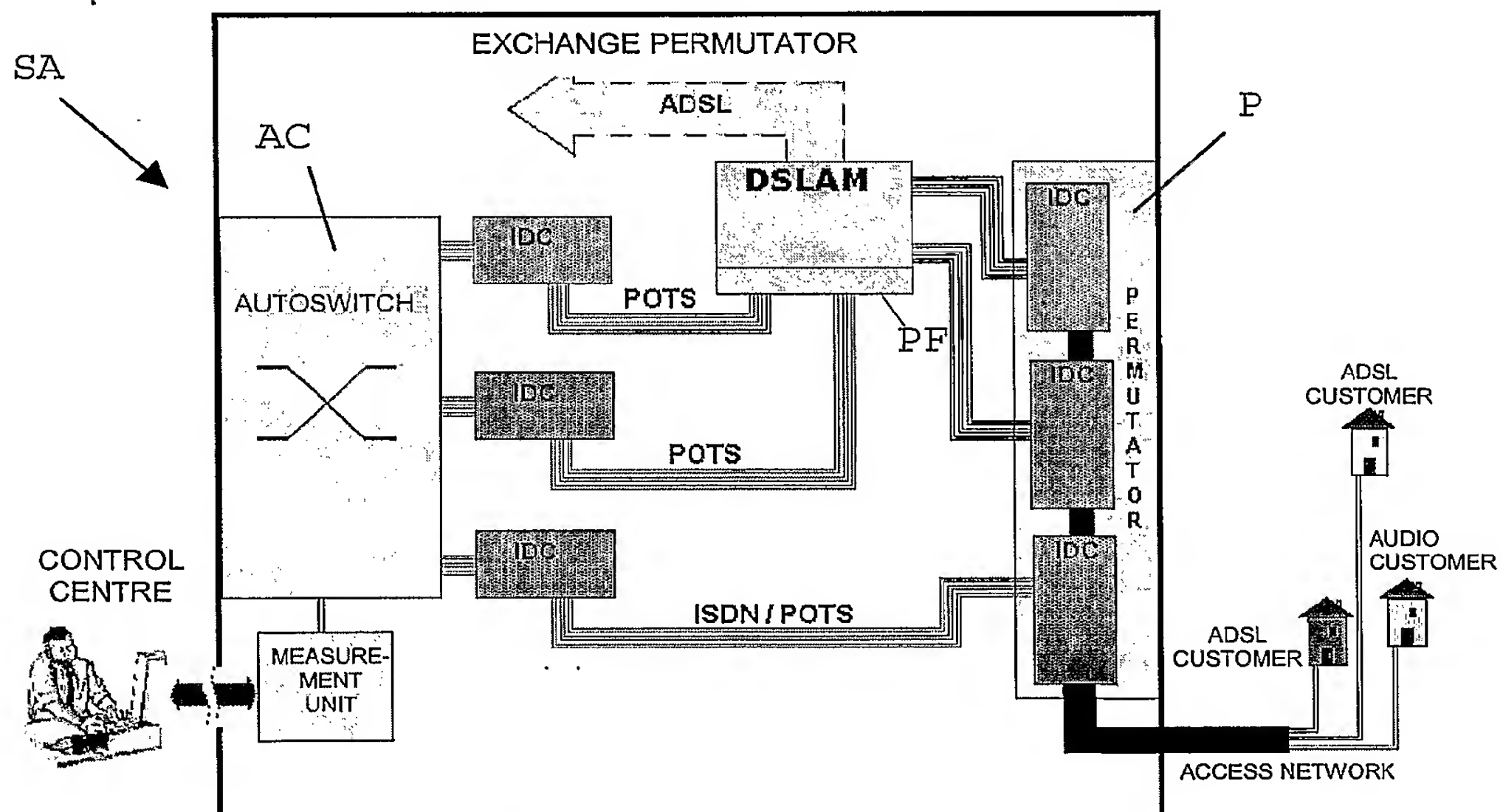
PRIOR ART

FIG. 2

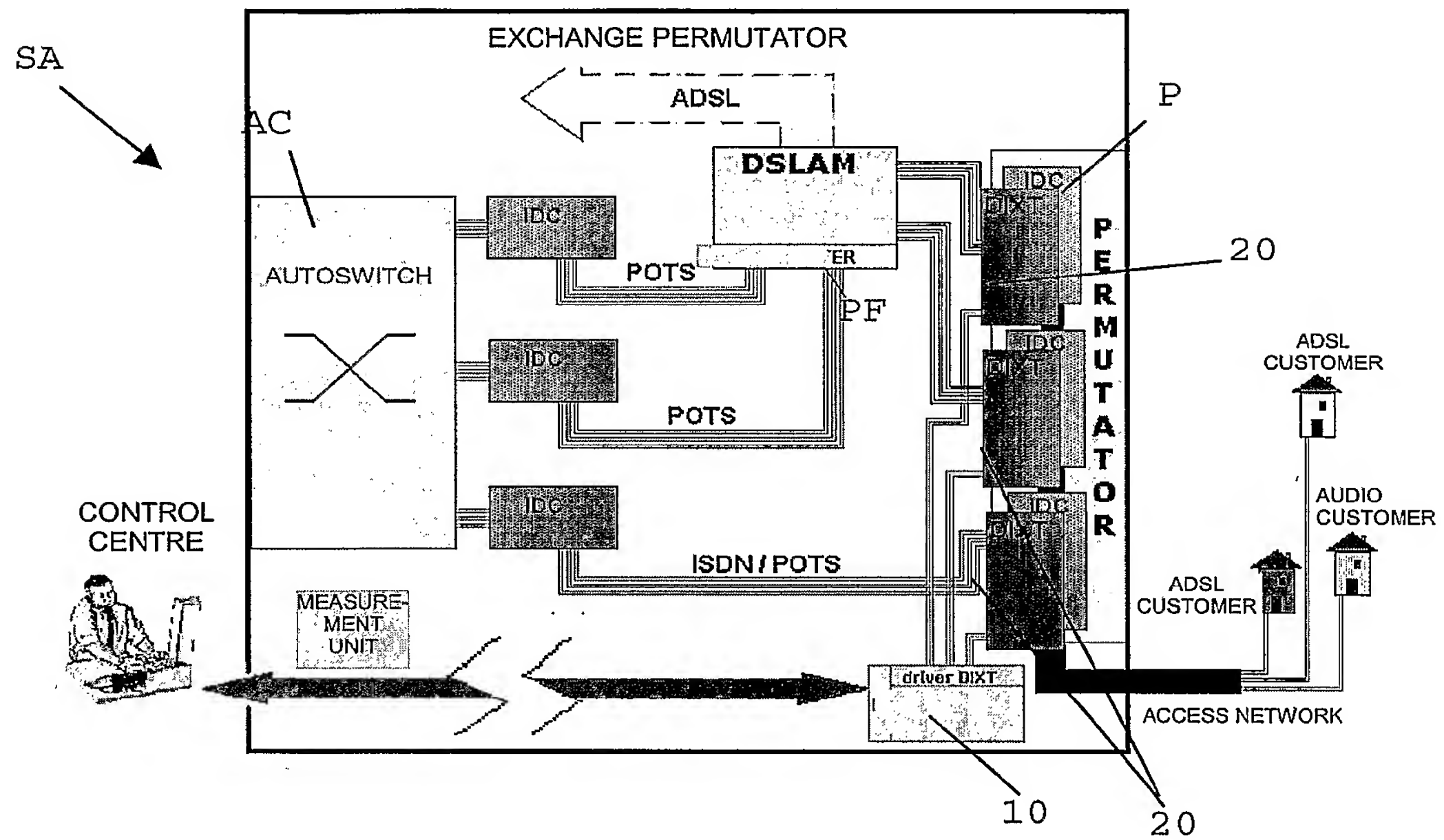


FIG. 3

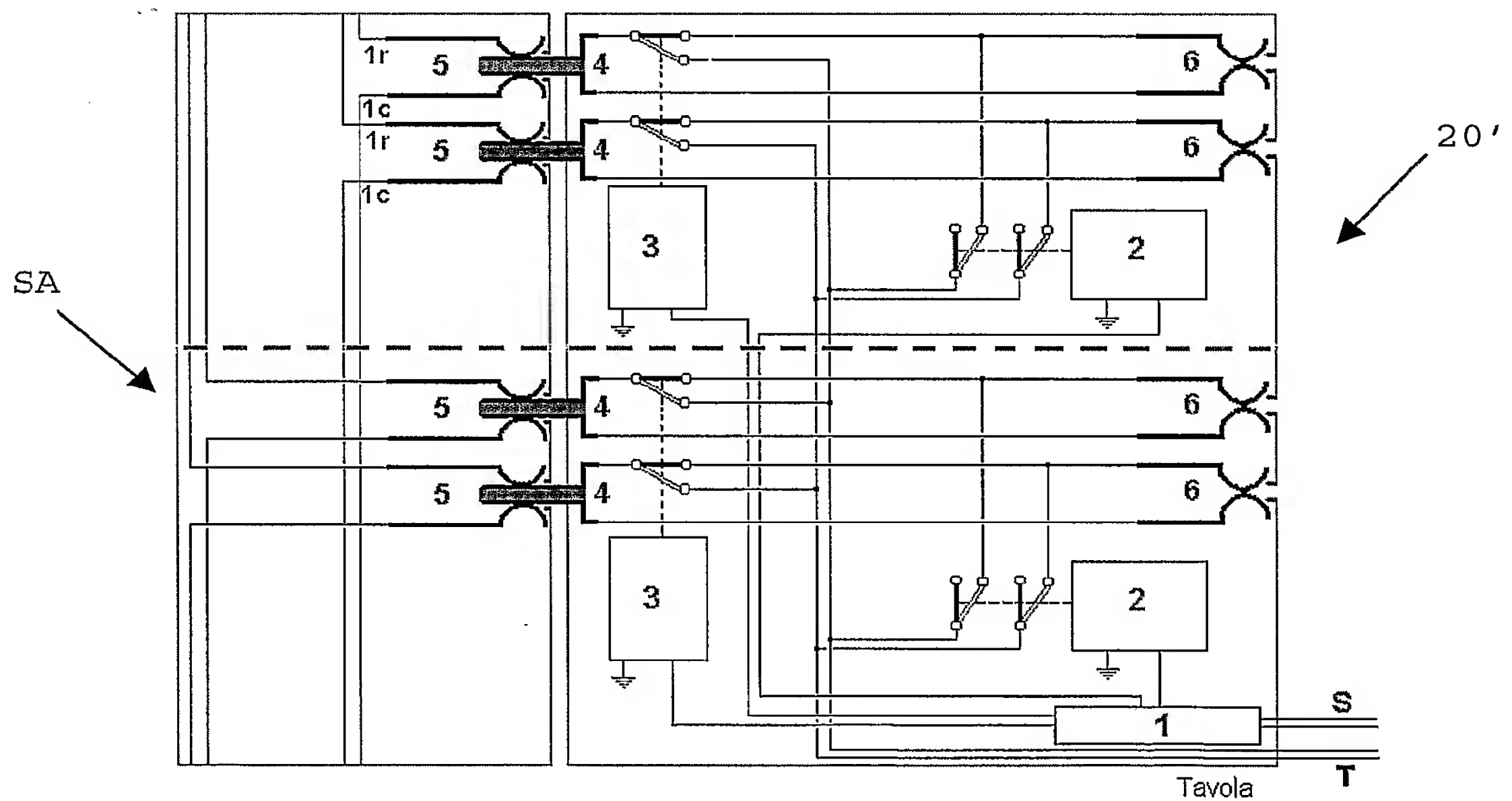


FIG. 6

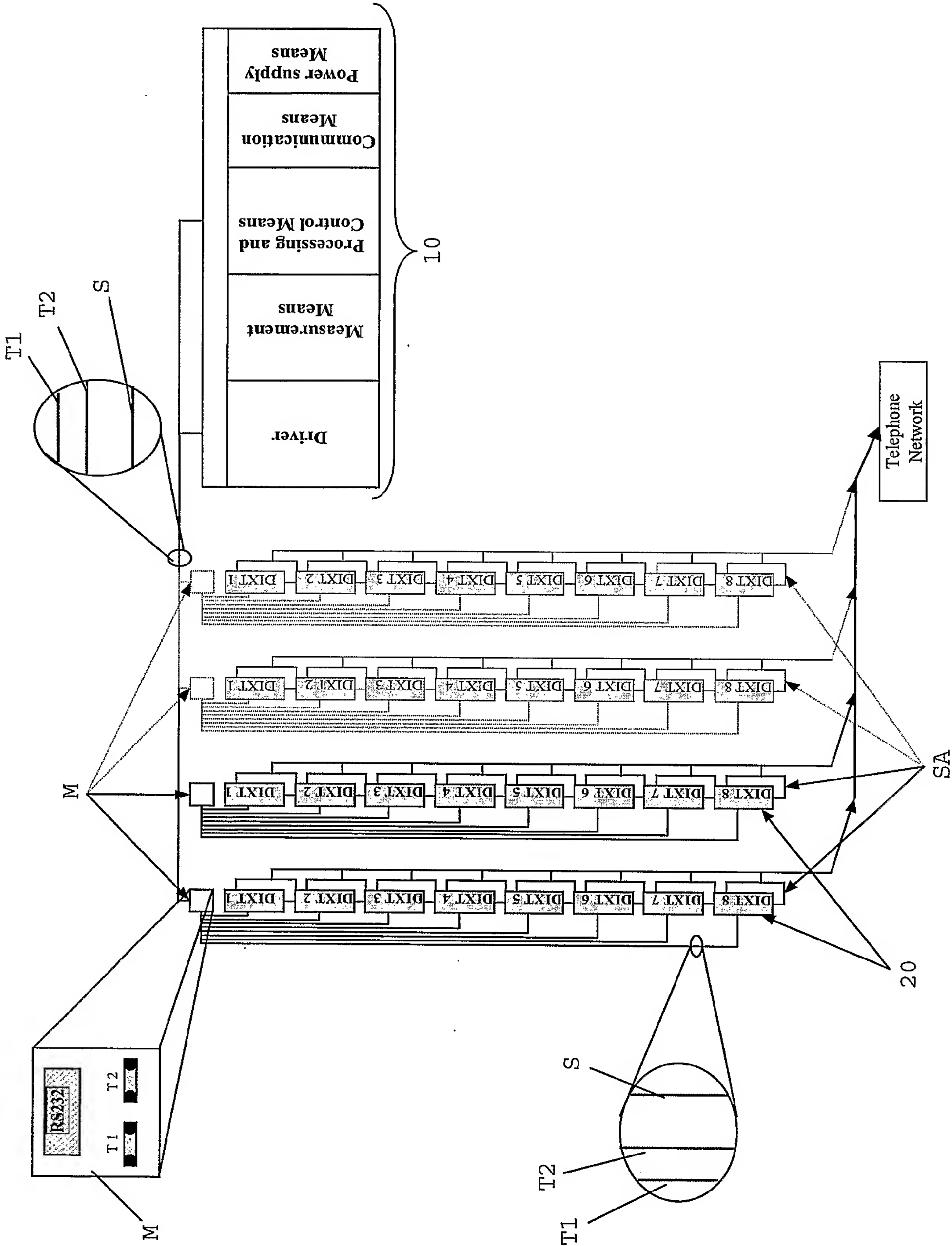


FIG. 4

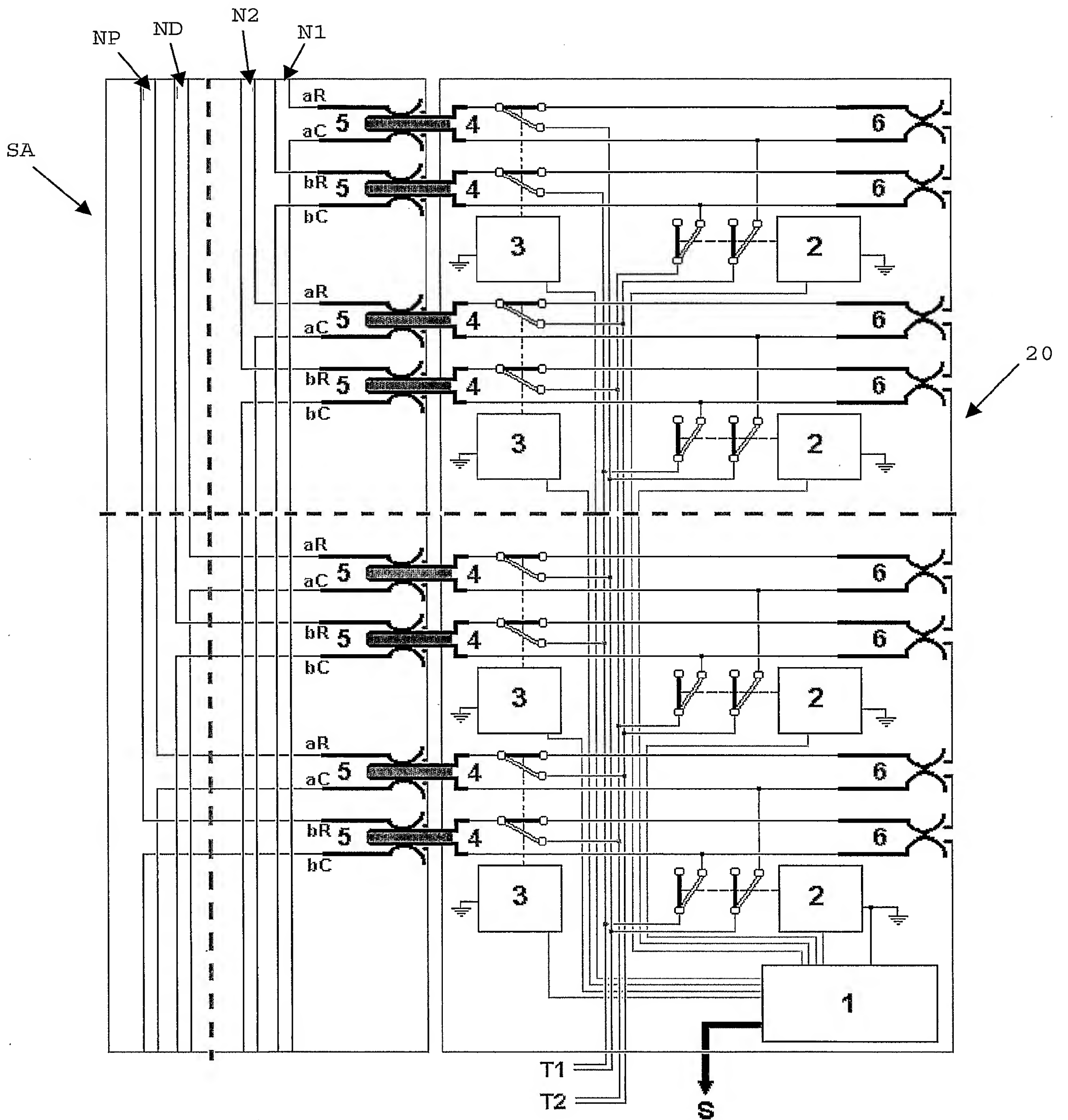


FIG. 5

INTERNATIONAL SEARCH REPORT

Internat~~ional~~ Application No

PCT/IT 03/00033

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04M3/30 H04Q1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04M H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	W0 99 14917 A (BENEDICT J M ET AL) 25 March 1999 (1999-03-25) abstract page 8, line 1 - line 10 page 10, line 35 -page 12, line 27 page 16, line 13 -page 18, line 11 figures 3-5	1-19
A	W0 01 93549 A (ZITTING B R ET AL) 6 December 2001 (2001-12-06) abstract page 5, line 14 -page 7, line 10 page 13, line 1 - line 20 figures 1-3	1-19

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Internat Application No

PCT/IT 03/00033

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